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(54) A flanged bearing ring for a bearing unit of a motor vehicle wheel

Lagerring mit Flansch für eine Fahrzeugradnabe

Anneau de roulement avec bride pour le moyeu d'une roue d'un véhicule

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EP 2 505 379 B1

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Description

[0001] The present invention relates to a lightweight, flanged bearing ring for the hub of a motor vehicle wheel, particularly a rotatable ring with a flange providing connection to the wheel and/or the brake rotor.

[0002] The motorcar industry has to comply with an ever increasing demand for weight reduction in motor vehicle components for the sake of cutting down fuel consumption and exhaust emissions. With a vehicle wheel bearing, weight reduction may not imply any reduction in strength and safety. The raceways must be made of a material hard enough to resist the stresses of rolling contact. Conventional bearing grade steel is still widely used. The raceways are heat treated so as to attain a level of hardness and microstructure homogeneity adequate to withstand the stresses caused by rolling Hertzian contact. Recent flanged bearing rings include a radially inner, annular or tubular insert (or core) made of bearing grade steel and forming one or two raceways, and a radially outer body forming a radially outwardly extending flange around the insert and made of a lightweight material such as aluminium alloy. The lightweight flange is designed to mount the wheel and/or the brake rotor and transfer loads from these components to the tubular insert.

[0003] WO 2008/147284 A1 discloses a bearing ring made up of two different materials joined together in a single piece, namely a first, high toughness material such as bearing grade steel forming the raceways and a second, lightweight material, such as a lightweight metal, forming the rest of the ring. The second material is joined to the first material by a forming process.

[0004] It has been observed that, with bearing rings of the above type, a weak point is given by the area where the interface surface between the two parts of different materials (tubular steel core, outer body of lightweight material) opens on the axially outer side, or outboard side of the bearing. In working conditions, micro-cracks along the interface surface between the two different materials tend inevitably to form.

[0005] In working conditions, the loads coming from the wheel transmit to the flange of the light-alloy outer body a bending moment which tends to separate the outer body from the core. Furthermore, repeated cycles of thermal stresses cause a differential thermal expansion between the outer body made of aluminum and the steel core, which has a coefficient of thermal expansion lesser than that of aluminum alloys. The infiltration of contaminants such as water, dust, salt, over time causes microcracks to broaden and the formation of rust. Experimental tests carried out by the Applicant have shown the occurrence of problems of galvanic corrosion with the use of certain types of light alloy, having a considerable difference in electrochemical potential than the steel. Salt, or even more simply water, can in fact be an electrolytic means having a high capability of penetration in microcracks. Because of all these factors, there is a risk that the coupling between the outer body of light alloy and steel core deteriorates, resulting in fretting (sliding) and possibly failure of the flanged ring.

[0006] It is an object of the invention to provide a bearing ring made of two parts of different materials coupled together in a reliable, long-lasting and watertight manner, so as to overcome the inconveniences of above-mentioned state of the art.

[0007] The above and further objects and advantages are attained, in accordance with the invention, by a flanged bearing ring having the features set forth in claim 1. Preferred embodiments of the invention are defined in the dependent claims.

[0008] In order that the present invention may be well understood there will now be described a preferred embodiment thereof, given by way of example, reference being made to the accompanying drawings, in which:

- Figure 1 is an axial cross-sectional view of a first embodiment of a flanged bearing ring according to the invention;
- Figure 2 is an enlarged view of a detail of figure 1 with an annular gasket mounted in a groove of the ring;
- Figure 3 shows the insertion of the gasket of Figure 2 in the bearing ring of Figure 1;
- Figure 4 is a view, similar to that of Figure 2, showing a variant of the shape of the groove;
- Figure 5 is a view, similar to that of Figure 1, showing a ring with a groove of different shape;
- Figure 6 shows the ring of Figure 5 with a gasket mounted in the groove;
- Figure 7 shows an enlarged view of the groove of the ring of Figures 5 and 6.
- Figure 8 shows a gasket, in the mounted condition and immediately prior to its insertion into the groove;
- Figure 9 is a view, similar to Figure 7, of a further variant of the shape of the groove, and
- Figure 10 shows a further variant of the shape of the gasket.

[0009] Referring initially to figure 1, designated overall at 10 is a flanged bearing ring in accordance with an embodiment of the invention. The ring 10, in this example, is designed to be the outer, rotatable ring of a double-row angular contact ball bearing for vehicle applications, particularly for mounting to a vehicle wheel (not shown) to be rotationally supported relative to a stationary suspension standard (not shown) of the vehicle around a central axis of rotation x. Throughout the present description and the claims, terms and expressions indicating positions and directions such as "radial" and "axial" are understood as referring to the axis of rotation x of the bearing. Expressions such as "axially inner" and "axially outer" instead refer to a condition when mounted on a vehicle.

[0010] The ring 10 comprises a radially inner insert or core 15 of a generally tubular shape and a radially outer body 16 providing a radially outwardly extending flange

17 at the outboard side of the core 15. The flange 17 provides a number of bores 18 to allow connection to the vehicle wheel by means of stud bolts (not shown).

[0011] The core 15 forms two raceways 11, 12 and is made of a first, hard and tough material, preferably a bearing grade steel. The radially outer body 16 is made of a second, lightweight material. A lightweight metal is preferred, such as aluminium, magnesium, or alloys thereof. Other suitable materials for the outer body may include, but not be limited to, carbon composites or reinforced polymers.In order to provide adequate structural support to the outer body 16, the steel core 15 extends axially through the whole width of the outer body, from the inboard to the outboard side. The tubular core 15 forms an axial tubular extension or spigot 19 at its outboard side, which facilitates centring of the vehicle wheel. The spigot 19 protrudes axially from a radially outer surface 20 of the flange 17, facing an axially outer direction.

[0012] The outer body 16 is formed around the core 15 in a number of different ways, for example through a semi-solid casting process, or by sintering or casting, or die-casting. At the end of any of these processes, the lightweight material tightly copies the shape of the radially outboard surface of core 15, whereby the inner and outer bodies interlock with one another. The shape of the radially outboard surface of the core 15 is so formed as to provide a series of grooves and ridges which extend in the circumferential direction and determine the formation of complementary ridges and grooves in the outer body when this is formed around the core.

[0013] Towards the axially inner ends, the core 15 forms a ridge 13 which projects in a radially outer direction and extends in a circumferential direction. The ridge 13 serves as a shoulder to oppose relative axial displacement between the outer body 16 and the core 15. The ridge 13 provides an axially outer radial surface 14 which is coplanar, or substantially coplanar, with the axially outer surface 20 of flange 17; the surface 20 defines a precise reference surface against which the wheel or brake disc will rest.

[0014] At the axially outer end ring, at the outboard side where the flange 17 is provided, the interface surface between the outer body and the core ends in a groove 21 formed partly by the outer body 16 and partly by the inner core 15. It is noted that the interface surface terminates in a position which is recessed with respect to the axially inner radial surfaces 20 of the flange 17 and 14 of the ridge 13.

[0015] The groove 21, which opens in an axially outer direction, may be obtained by turning in a terminal step of the manufacturing process of the ring, that is, after the outer body 16 has already been formed around the core 15. As an alternative, the groove 21 may be produced during the same manufacturing step in which the outer body is formed around the core, for example by means of an annular insert placed in the moulding cavity.

[0016] Accommodated in the groove 21 is an annular gasket 22 of rubber or elastomeric material which exerts a hermetic sealing action both against the outer body 16 and the core 15. Therefore, the annular gasket 22 continuously covers and closes, along an entire circumference around the axis x, a separation line 23 between the steel of the core 15 and the lightweight metal of the outer body 16, where the interface surface between these two materials meets the outboard side of the ring 10.

[0017] Preferably, as shown in the enlargement of Figure 2, the groove 21 is obtained to a greater extent in the outer body of lightweight metal 16, and to a lesser extent in the ridge 13 of the core 15. Due to this arrangement, a minor quantity of the material (steel) that provides the greatest contribution in terms of structural strength is removed, and therefore the ridge 13 is not weaken to an appreciable extent.

[0018] In the embodiment illustrated in Figure 3, the groove 21 has a rounded bottom 21a and two coaxial cylindrical surfaces 21b, 21c between which the gasket 22 is forcefully inserted, for example by means of a punch A and a guide B, so that the gasket, once inserted in the groove, remains trapped in it in a radially compressed condition with respect to its undeformed condition 22' prior to the assembly. In the embodiment of Figure 4, the opening 21d of the groove 21 has a radial dimension smaller than the radial distance between the coaxial cylindrical surfaces 21b, 21c, in order to retain the gasket within the groove and prevent it from accidentally coming out of the groove. Preferably, the narrowing of the opening 21d is achieved by creating an edge 21e protruding in a radial direction from the outer body 16 toward the core 15. Alternatively, the edge 21e can be formed as an edge protruding from the core 15 towards the outer body 16. The creation of a conical surface 21f, tapered in an axially inner direction, i.e. away from the opening 21d, opposes the escape of the gasket from the groove and helps the gasket 22 to reach its correct working position when it is inserted in the groove.

[0019] Figures 5 to 9 show further variants with annular seals 22 of circular cross-section. The presence of an edge 21e at the opening 21d of the groove keeps the annular gasket spaced from the brake disc (indicated in dashed lines at C in Figure 6). As shown for example in Figure 7, the projecting edge 21f has a diameter d21f greater than the diameter d21g of the axially inner end of the groove, where there is formed a rounded portion 21g having a radius corresponding to the radius of the transversal cross-section of the gasket. In all variants of the invention, it is possible to use a gasket which has, in its free or undeformed condition, a smaller diameter than that of the groove in which the gasket is mounted. The gasket (Figure 8) should be elastically enlarged (as indicated schematically at 22") in order to get over the edge 21e and then shrink steadily in its seat after being fitted deep in the groove 21. The tapered surface 21f, which is concave in this example, favors the retaining of the gasket in the groove 21.

[0020] Preferably, the annular gasket 22 does not project axially beyond the flat surface defined by the sur-

faces 20 and 14, but only partly fills the groove 21. Owing to this arrangement, the brake disk C does not contact the gasket 22, and therefore rests only against the flat surfaces 20 and 14. Otherwise, in case the gasket 22 should protrude axially beyond the surfaces 14 and 20, it could cause planarity errors of the braking surfaces of the brake disc. In addition, the absence of contact between the gasket and the brake disc prevents the drawback that the warm brake disc may melt the elastomeric or rubber material and tear it out of its seat when removing the brake disc for servicing. Those skilled in the art will readily recognize that many variants and combinations can be made with respect to the embodiments herein described and illustrated. For example, Figure 9 shows a variant with a tapered surface 21f and a rounded seat to receive a gasket of circular cross-section. In Figure 10, the gasket 22 has two bevels to facilitate its insertion into the groove.

[0021] Not necessarily the bottom of the groove 21 must have a rounded profile as shown. A rounded shape is preferable if one chooses to make a groove with thin dimensions, using a thin turning tool having a rounded head.

Claims

1. A flanged bearing ring for a motor vehicle wheel, wherein the ring (10) comprises two different materials joined together as a single piece, the ring including:

- a radially inner tubular or annular core (15) which forms at least one raceway (11) around a central axis of rotation (x), the core (15) providing a radially outer surface and being made of a first high toughness material;
- a radially outer body (16) which is formed around said outer surface of the core (15), forms a radially outwardly extending flange (17) around the core (15) and is made of a second material being lighter than the first material;

characterized in that at an axially outer end of the ring (10) where the flange (17) is provided, interface surfaces
between the outer body (16) and the core (15) terminate in a groove (21) which is formed partly in the outer body (16) and partly in the core, and that accommodated in the groove (21) is an annular sealing gasket (22) of rubber-like or elastomeric material which is pressed against both the outer body (16) and the core (15) so as to seal continuously, along an entire circumference around the axis (x), a separation line (23) at the axially outer end of the interface surfaces between the core (15) and the outer body (16).

2. A flanged ring according to claim 1, **characterized in that** the groove (21) opens in an axially outward direction forming an annular opening (21d) bounded by a rim (21e) which is formed by at least one of said outer body (16) and core (15) and projects radially towards the other of said cores (15) and outer body (16).

3. A flanged ring according to claim 2, **characterized in that** the rim (21e) is formed by the core (15) and protrudes in a radially outward direction.

4. A flanged ring according to any of the preceding claims, **characterized in that** the sealing gasket (22) is elastically compressed in a radial direction between two coaxial cylindrical surfaces (21b, 21c) of the groove (21), wherein the surfaces are obtained in the housing (16) and in the core (15), respectively.

5. A flanged ring according to claim 4 as dependent on claim 2 or 3, **characterized in that** the annular gap (21d) has a radial width which is less than the radial distance between the coaxial cylindrical surfaces (21b, 21c).

6. A flanged ring according to claim 3, **characterized in that** the groove (21) has a surface (21f) tapering in an axially outer direction towards the opening (21d) of the groove.

7. A flanged ring according to claim 6, **characterized in that** the tapered surface (21f) is conical.

8. A flanged ring according to any of the preceding claims, **characterized in that** part of the groove (21) formed in the core (15) is obtained in a ridge or shoulder (13) which protrudes in a radially outer direction and extends in a circumferential direction.

9. A flanged ring according to claim 8, **characterized in that** the groove (21) is obtained for its majority in the housing (16), and to a lesser extent in the crest (13) of the core (15).

10. A flanged ring according to claim 8 or 9, **characterized in that**
the ridge (13) has an axially outer radial surface (14) coplanar or substantially coplanar with an axially outer, radial surface (20) of the flange (17),
the groove (21) separates the surfaces (14) and (20), and that
the sealing gasket (22) only partially fills the groove (21) without projecting axially beyond the radial plane in which the surface (20) lies.

11. A flanged ring according to any of the preceding claims, **characterized in that** the annular gasket (22) is entirely axially recessed with respect to the radial plane in which the axially outer radial surface

(20) of the flange (17) lies.

12. A flanged ring according to any of the preceding claims, **characterized in that** the seal ring (22) has, in a free or undeformed condition, a diameter which is less than the minimum diameter of the groove (21).

13. A flanged ring according to claims 3 and 12, **characterized in that** the seal ring (22) has, in a free or undeformed condition, a diameter which is less than the maximum diameter of the rim (21e).

Patentansprüche

1. Lagerring mit Flansch für ein Kraftfahrzeugrad, wobei der Ring (10) zwei unterschiedliche Materialien umfasst, die zu einem Einzelteil miteinander verbunden sind, wobei der Ring Folgendes aufweist:

einen radial inneren rohrförmigen oder ringförmigen Kern (15), der mindestens einen Umlauf (11) um eine zentrale Drehachse (x) bildet, wobei der Kern (15) eine radial äußere Oberfläche bereitstellt und aus einem ersten Material mit hoher Härte hergestellt ist;
einen radial äußeren Körper (16), der um die äußere Oberfläche des Kerns (15) gebildet ist und einen sich radial nach außen erstreckenden Flansch (17) um den Kern (15) bildet und aus einem zweiten Material hergestellt ist, das leichter als das erste Material ist;
dadurch gekennzeichnet, dass an einem axial äußeren Ende des Rings (10), an dem der Flansch (17) bereitgestellt ist, Schnittstellenoberflächen zwischen dem äußeren Körper (16) und dem Kern (15) in einer Nut (21) enden, die teilweise in den äußeren Körper (16) und teilweise in dem Kern ausgebildet ist, und dadurch, dass in der Nut (21) eine ringförmige Flanschdichtung (22) aus kautschukartigem oder Elastomermaterial aufgenommen ist, die sowohl gegen den äußeren Körper (16) als auch Kern (15) gepresst wird, um diesen entlang eines gesamten Umfangs um die Achse (x), entlang einer Trennlinie (23) an dem axial äußeren Ende der Schnittstellenoberflächen zwischen dem Kern (15) und dem äußeren Körper (16) kontinuierlich abzudichten.

2. Ring mit Flansch nach Anspruch 1, **dadurch gekennzeichnet, dass** sich die Nut (21) in eine axial äußere Richtung öffnet und eine ringförmige Öffnung (21d) bildet, die von einer Felge (21e) begrenzt wird, die von mindestens entweder dem äußeren Körper (16) oder dem Kern (15) gebildet wird und radial nach außen in Richtung des anderen von Kern (15) und äußeren Körper (16) hervorsteht.

3. Ring mit Flansch nach Anspruch 2, **dadurch gekennzeichnet, dass** die Felge (21e) von dem Kern (15) gebildet wird und in eine radial äußere Richtung hervorsteht.

4. Ring mit Flansch nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** die Flanschdichtung (22) elastisch in eine radiale Richtung zwischen zwei koaxiale zylinderförmige Oberflächen (21b, 21c) der Nut (21) gepresst wird, wobei die Oberflächen in dem Gehäuse (16) bzw. in dem Kern (15) erhalten werden.

5. Ring mit Flansch nach Anspruch 4 in Abhängigkeit von Anspruch 2 oder 3, **dadurch gekennzeichnet, dass** der ringförmige Spalt (21d) eine radiale Breite aufweist, die geringer als der radiale Abstand zwischen den koaxialen zylinderförmigen Oberflächen (21b, 21c) ist.

6. Ring mit Flansch nach Anspruch 3, **dadurch gekennzeichnet, dass** die Nut (21) eine Oberfläche (21f) aufweist, die sich in eine axiale Richtung nach außen zu der Öffnung (21d) der Nut verjüngt.

7. Ring mit Flansch nach Anspruch 6, **dadurch gekennzeichnet, dass** die verjüngte Oberfläche (21f) kegelförmig ist.

8. Ring mit Flansch nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** ein Teil der Nut (21), die in dem Kern (15) ausgebildet ist, in einer Erhöhung oder Schulter (13) erhalten wird, die in eine radiale Richtung nach außen ragt und sich in eine Umfangsrichtung erstreckt.

9. Ring mit Flansch nach Anspruch 8, **dadurch gekennzeichnet, dass** die Nut (21) hauptsächlich in dem Gehäuse (16) erhalten wird und in geringerem Maße in dem Scheitel (13) des Kerns (15).

10. Ring mit Flansch nach Anspruch 8 oder 9, **dadurch gekennzeichnet, dass**:

die Erhöhung (13) eine axial äußere radiale Oberfläche (14) aufweist, die koplanar oder im Wesentlichen koplanar zu einer axial äußeren radialen Oberfläche (20) des Flansches (17) verläuft;
die Nut (21) die Oberflächen (14) und (20) trennt, und dadurch, dass
die Flanschdichtung (22) nur teilweise die Nut (21) füllt, ohne axial über die Radialebene hinauszuragen, in der die Oberfläche (20) liegt.

11. Ring mit Flansch nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** die ringförmige Flanschdichtung (22) in Bezug auf die radiale

Ebene, auf der die radial axiale, äußere Oberfläche (20) des Flansches (17) liegt, vollständig axial versenkt ist.

12. Ring mit Flansch nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** der Dichtungsring (22) in einem freien oder nicht verformten Zustand einen Durchmesser aufweist, der kleiner als der minimale Durchmesser der Nut (21) ist.

13. Ring mit Flansch nach einem der vorherigen Ansprüche 3 und 12, **dadurch gekennzeichnet, dass** der Dichtring (22) in einem freien oder nicht verformten Zustand einen Durchmesser aufweist, der kleiner als der maximale Durchmesser der Felge (21e) ist.

Revendications

1. Bague de roulement à collerette pour une roue de véhicule automobile, la bague (10) comprenant deux matériaux différents assemblés sous la forme d'une pièce unique, la bague comprenant :

- une partie centrale (15) tubulaire ou annulaire radialement intérieure qui forme au moins un chemin de roulement (11) autour d'un axe central de rotation (x), la partie centrale (15) formant une surface radialement extérieure, et étant faite d'un premier matériau à forte ténacité ;
- un corps radialement extérieur (16) qui est formé autour de ladite surface extérieure de la partie centrale (15), forme une collerette (17) s'étendant radialement vers l'extérieur autour de la partie centrale (15) et est fait d'un second matériau plus léger que le premier matériau ;

caractérisée en ce qu'au niveau d'une extrémité axialement extérieure de la bague (10) où est formée la collerette (17), des surfaces d'interface entre le corps extérieur (16) et la partie centrale (15) se terminent dans une rainure (21) qui est formée en partie dans le corps extérieur (16) et en partie dans la partie centrale, et **en ce que** dans la rainure (21) est logé un joint d'étanchéité annulaire (22) constitué d'un matériau de type caoutchouc ou élastomère qui est pressé à la fois contre le corps extérieur (16) et contre la partie centrale (15) de façon à assurer une étanchéité de manière continue, le long de la totalité d'une circonférence autour de l'axe (x), au niveau d'une ligne de séparation (23) se trouvant à l'extrémité axialement extérieure des surfaces d'interface entre la partie centrale (15) et le corps extérieur (16).

2. Bague à collerette selon la revendication 1, **caractérisée en ce que** la rainure (21) est ouverte dans une direction axialement vers l'extérieur de façon à former une ouverture annulaire (21d) délimitée par un bord (21e) qui est formé par ledit corps extérieur (16) et/ou la partie centrale (15) et fait saillie radialement vers l'autre de ladite partie centrale (15) et dudit corps extérieur (16).

3. Bague à collerette selon la revendication 2, **caractérisée en ce que** le bord (21e) est formé par la partie centrale (15) et fait saillie dans une direction radialement vers l'extérieur.

4. Bague à collerette selon l'une quelconque des revendications précédentes, **caractérisée en ce que** le joint d'étanchéité (22) est comprimé élastiquement dans une direction radiale entre deux surfaces cylindriques coaxiales (21b, 21c) de la rainure (21), les surfaces étant respectivement obtenues dans le logement (16) et dans la partie centrale (15).

5. Bague à collerette selon la revendication 4 lorsqu'elle dépend de la revendication 2 ou 3, **caractérisée en ce que** l'interstice annulaire (21d) présente une largeur radiale inférieure à la distance radiale entre les surfaces cylindriques coaxiales (21b, 21c).

6. Bague à collerette selon la revendication 3, **caractérisée en ce que** la rainure (21) comporte une surface (21f) inclinée dans une direction axialement extérieure vers l'ouverture (21d) de la rainure.

7. Bague à collerette selon la revendication 6, **caractérisée en ce que** la surface inclinée (21f) est conique.

8. Bague à collerette selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'**une partie de la rainure (21) formée dans la partie centrale (15) est obtenue dans une proéminence ou un épaulement (13) qui fait saillie dans une direction radialement extérieure et s'étend dans une direction circonférentielle.

9. Bague à collerette selon la revendication 8, **caractérisée en ce que** la rainure (21) est obtenue en majeure partie dans le logement (16), et dans une moindre mesure dans la saillie (13) de la partie centrale (15).

10. Bague à collerette selon la revendication 8 ou 9, **caractérisée en ce que**
la saillie (13) comporte une surface radiale axialement extérieure (14) coplanaire ou essentiellement coplanaire avec une surface radiale axialement extérieure (20) de la collerette (17),
la rainure (21) sépare les surfaces (14) et (20), et **en ce que**
le joint d'étanchéité (22) ne remplit que partiellement la rainure (21) sans faire saillie axialement au-delà

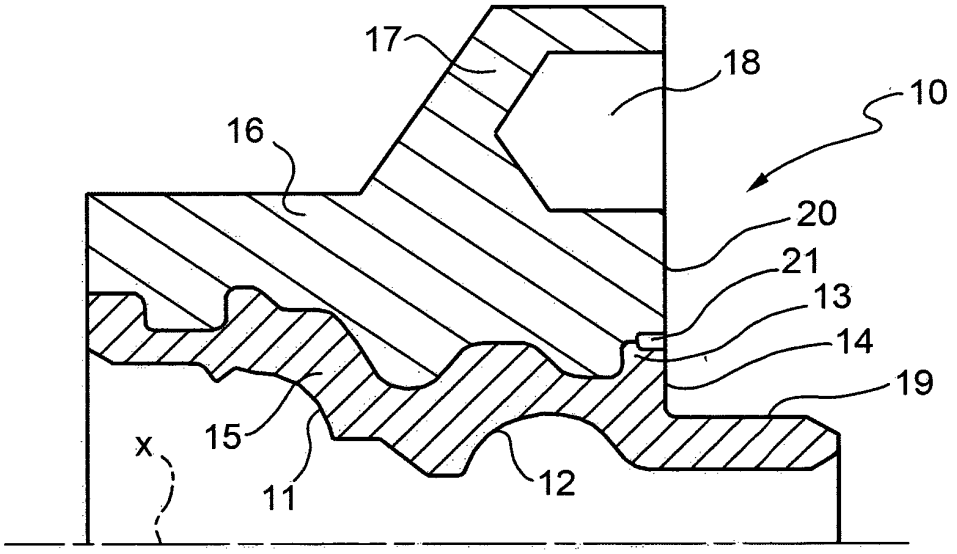
du plan radial dans lequel se trouve la surface (20).

11. Bague à collerette selon l'une quelconque des revendications précédentes, **caractérisée en ce que** le joint d'étanchéité (22) est entièrement en retrait axialement par rapport au plan radial dans lequel se trouve la surface radiale axialement extérieure (20) de la collerette (17).

12. Bague à collerette selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la bague d'étanchéité (22) présente, dans un état libre ou non déformé, un diamètre inférieur au diamètre minimum de la rainure (21).

13. Bague à collerette selon les revendications 3 et 12, **caractérisée en ce que** la bague d'étanchéité (22) présente, dans un état libre ou non déformé, un diamètre inférieur au diamètre maximum du bord (21e).

FIG.1



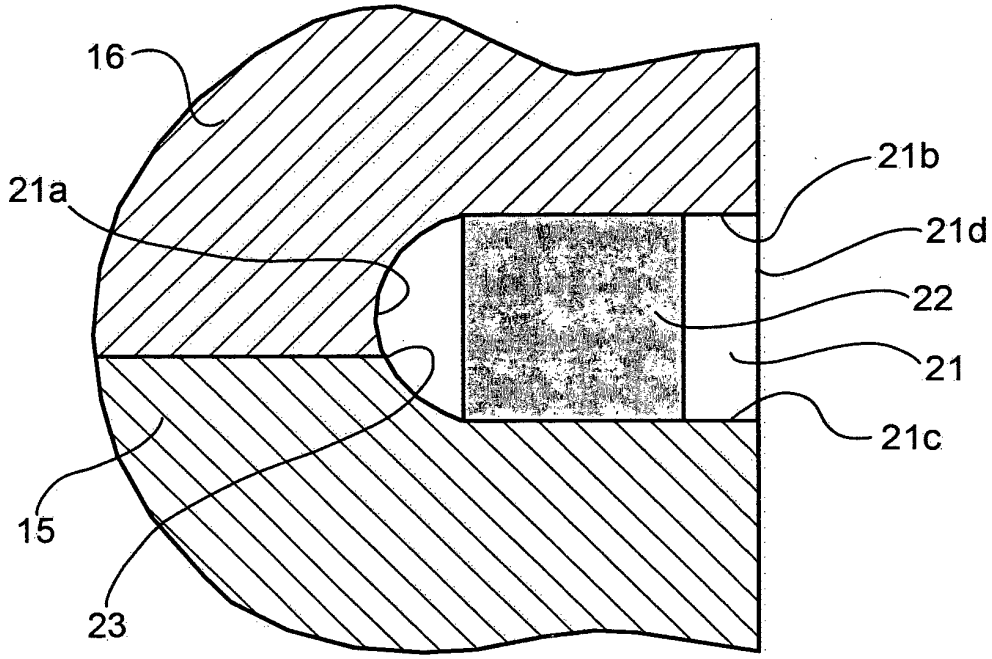


FIG.2

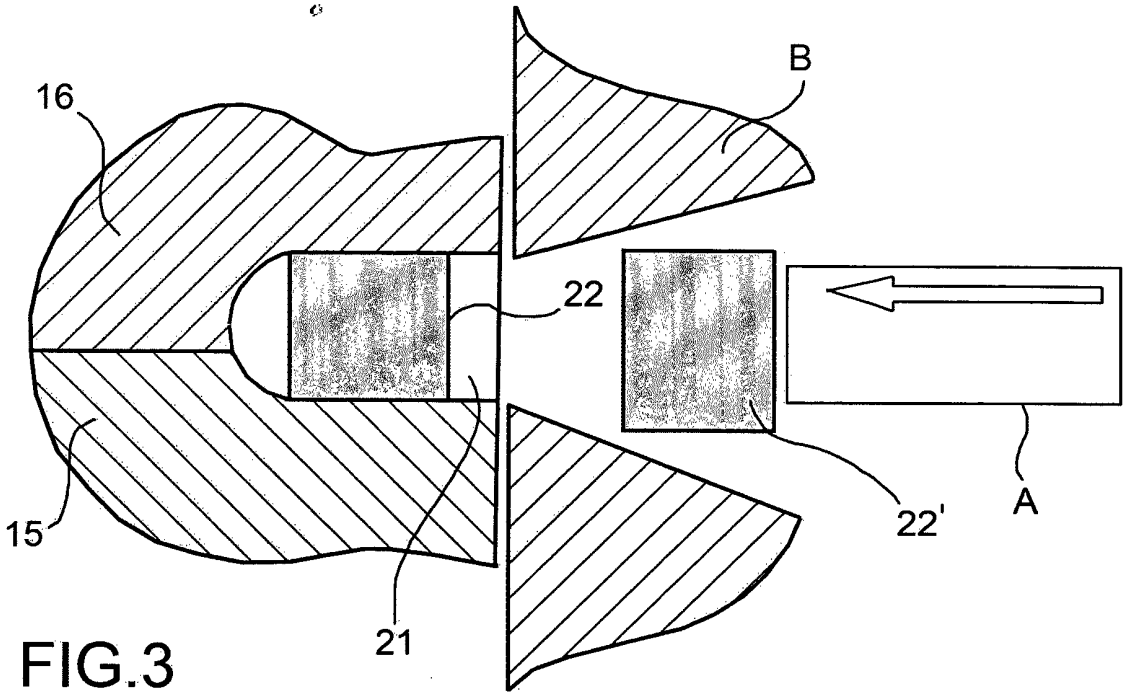


FIG.3

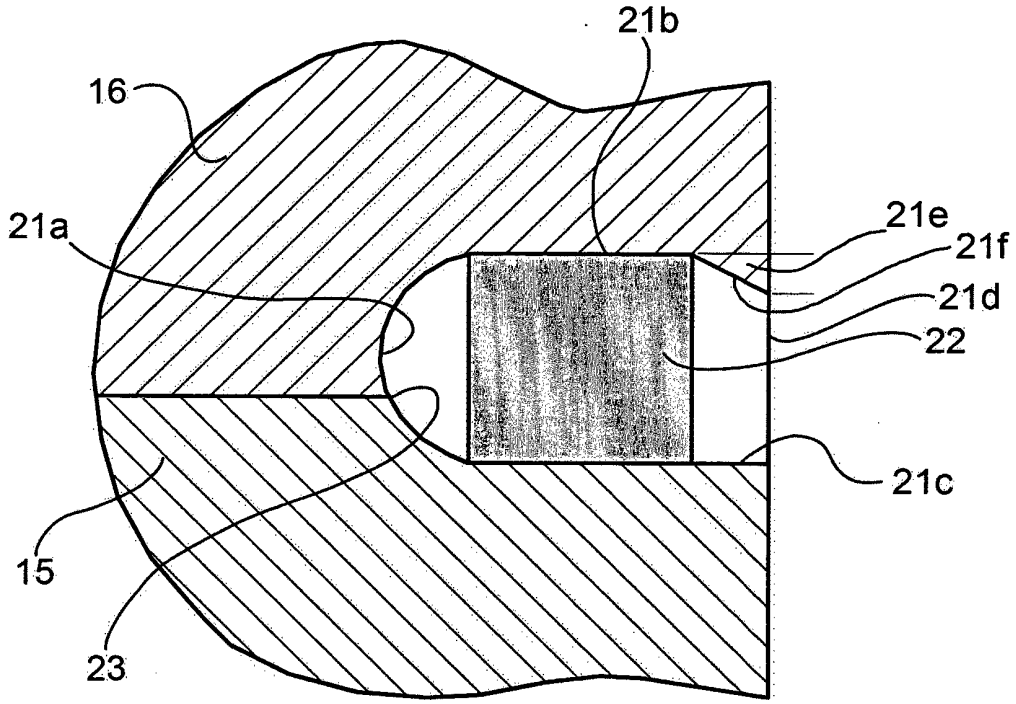


FIG.4

FIG.5

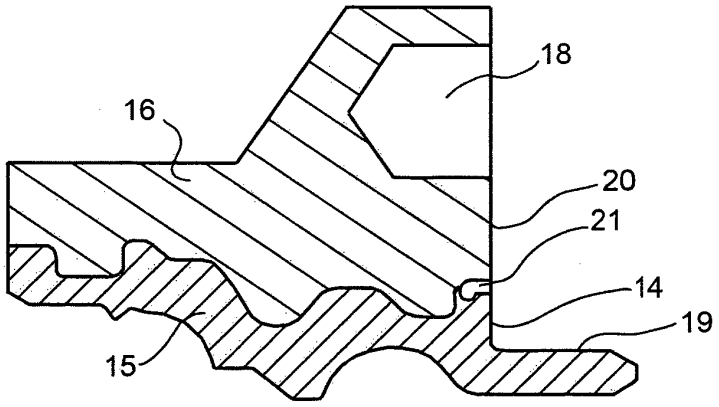


FIG.6

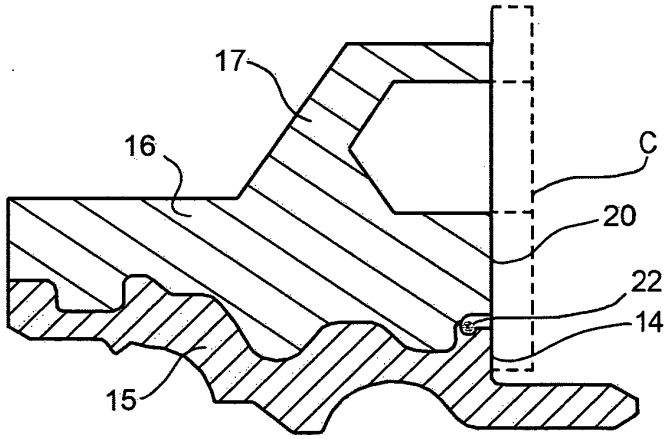


FIG.7

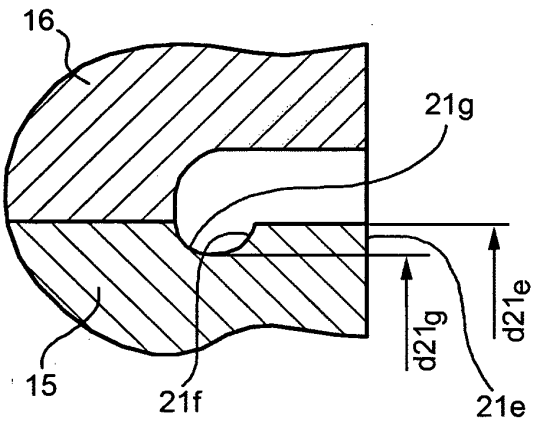
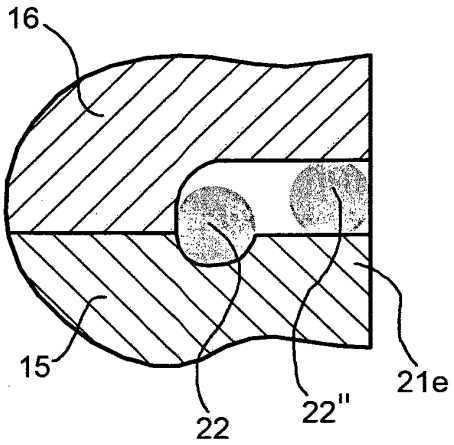


FIG.8



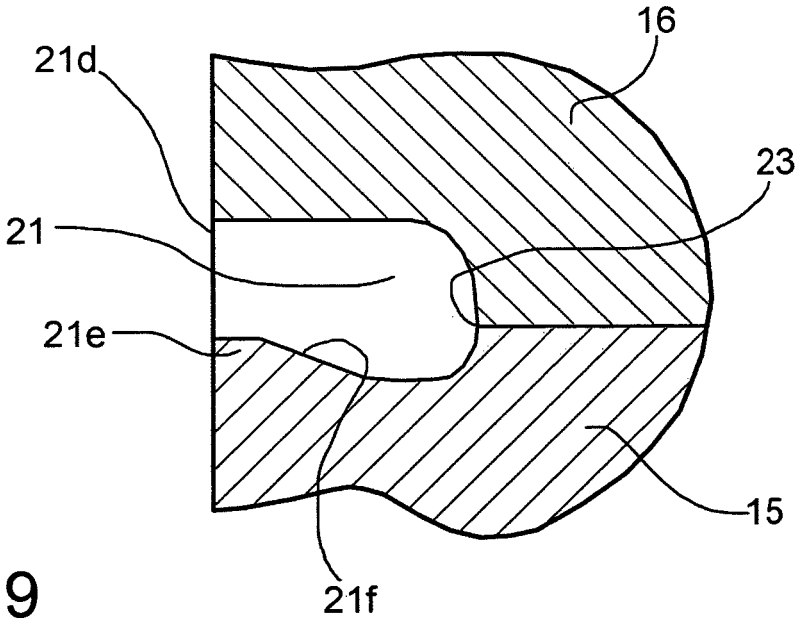


FIG.9

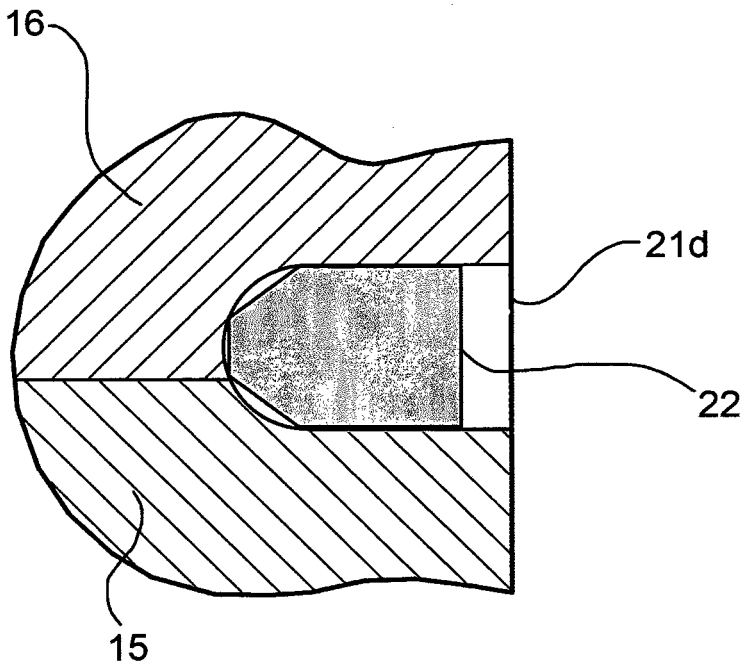


FIG.10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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